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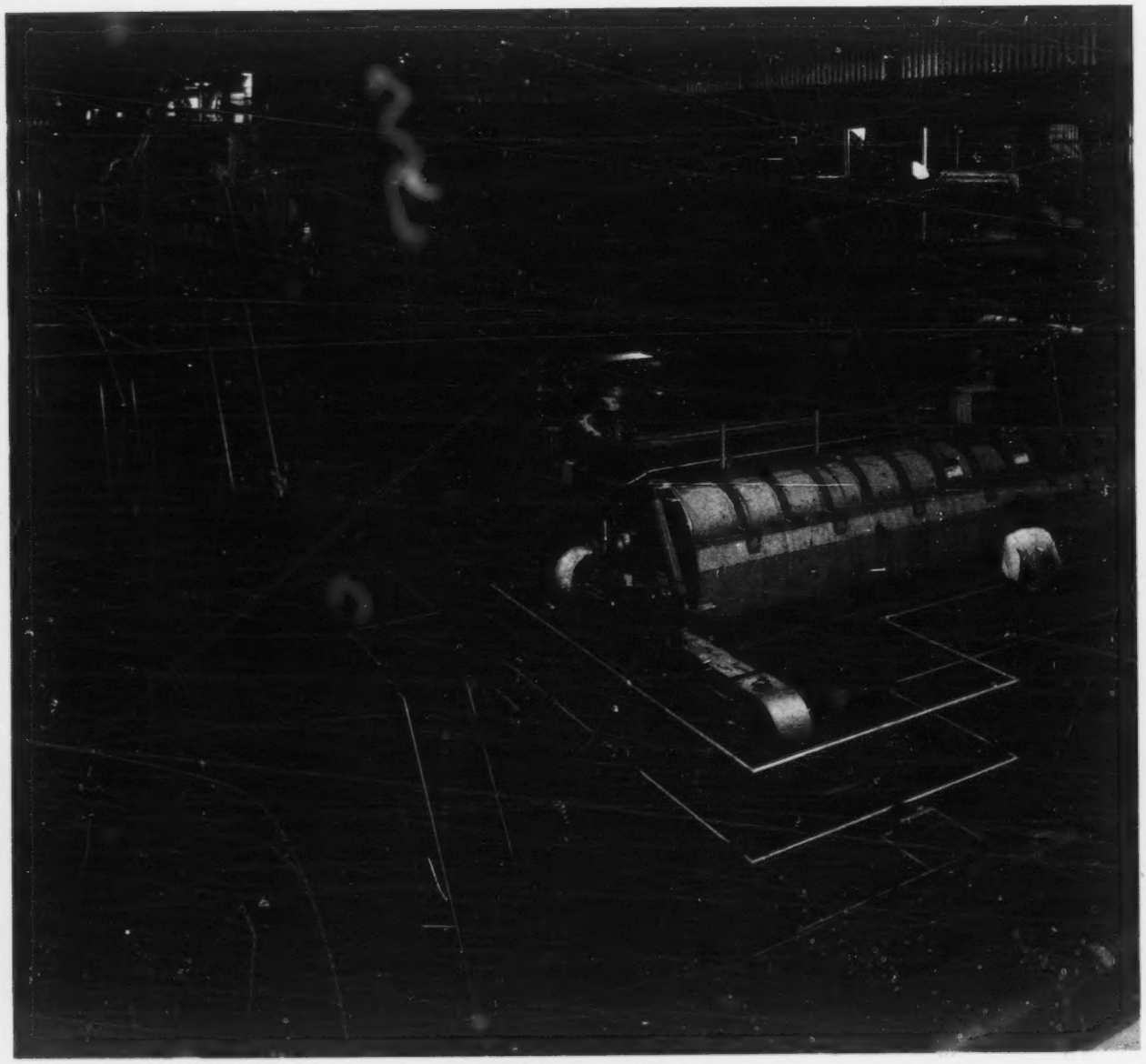
PULP & PAPER

April 1986



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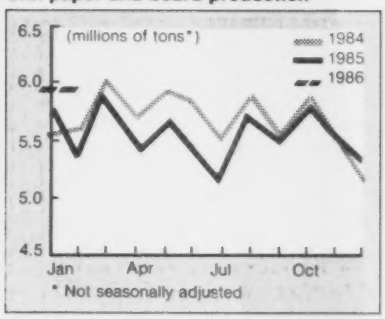
U.S. paper and board production



U.S. production of paper and paperboard got off to a good start in January, rising to 5.9 million tons for a gain of 2.7% over January 1985, the American Paper Institute reported. The two-month moving average of seasonally adjusted data for January topped 70 million tpy, a new high, and preliminary data for February showed that trend continuing.

Among major grades, the strength in paper demand was concentrated in newsprint, uncoated free-sheet and tissue grades, API said, although newsprint production lagged January 1985 levels. Coated paper fell behind strong year-earlier levels, while packaging papers continued to decline in the face of competition from plastics. Containerboard production and corrugated box shipments set new records in January, and the other paperboard grades also rose sharply. Linerboard production for export jumped 45.7% compared with depressed year-ago levels.

Canadian newsprint shipments totaled 713,000 metric tons in January, down 3.5% from a year earlier. Operating rates fell from 96% in December to 94% in January. Canadian pulp shipments jumped 4.6% in January to 563,000 tons, while operating rates rose to 89% from 86% the previous month. ■

	Latest month (000 short tons)		% change from year ago	Annualized year-to-date (000 short tons)	% change from year ago
PAPER & PAPERBOARD PRODUCTION[1]					
Newsprint	Jan.	463	−1.3	5,558	−1.1
Uncoated groundwood (s)	Jan.	128	4.9	1,535	1.6
Coated paper (s)	Jan.	521	−6.3	6,256	−7.5
Uncoated free sheet (s)	Jan.	885	11.5	10,616	11.4
Other printing/writing	Jan.	116	−1.7	1,395	−1.1
Total packaging and other paper (s)	Jan.	436	−4.4	5,234	−3.9
Tissue	Jan.	429	6.5	5,148	3.1
Total paper	**Jan.**	**2,979**	**2.1**	**35,744**	**1.6**
Unbleached kraft paperboard	Jan.	1,461	3.8	17,530	3.8
Semichemical medium	Jan.	443	6.2	5,318	6.3
Bleached paperboard	Jan.	351	3.8	4,210	7.5
Recycled paperboard	Jan.	684	0.3	8,212	4.1
Total paperboard	**Jan.**	**2,939**	**3.3**	**35,271**	**4.6**
Total U.S. paper and paperboard output	**Jan.**	**5,918**	**2.7**	**71,015**	**3.1**
PULP, WASTEPAPER & FIBER[2]					
Total U.S. woodpulp production	Dec.	4,363	0.3	54,081	−2.6
Market pulp production	Dec.	537	−0.6	6,790	−1.5
Wastepaper consumption at paper/board mills	Dec.	1,207	−0.1	15,290	−2.8
Pulpwood consumption (cords)	Dec.	6,907	0.5	85,744	−2.2
CONVERTED PRODUCTS STATISTICS[3]					
Corrugated box shipments (billion ft²)	Jan.	24.075	4.1	24.075[6]	4.1
Containerboard inventories at U.S. box plants and mills	Jan. 1	2,477	0.3		
INTERNATIONAL TRADE[2]					
U.S. paper imports (including products)	Dec.	889	8.8	11,105	5.0
Imports of Canadian newsprint	Dec.	663	6.1	8,118[6]	5.7
U.S. paper exports (including products)	Dec.	332	10.3	4,008	−7.0
Exports of unbleached kraft linerboard	Jan.	173	57.3	2,077	45.7
Exports of woodpulp	Dec.	295	−5.1	3,791	5.5
Norscan pulp inventories[4]	Jan. 31	1,327	2.2		
Norscan pulp operating rates[4]	Jan.	85%	75%	92%	90%
CANADIAN STATISTICS[5] *(reported in metric tons)*					
Total newsprint shipments	Jan.	713	−3.5	713[6]	−2.8
Operating rates	Jan.	94%	96%	94%	96%
Inventories held by U.S. consumers	Jan. 31	1,399	−0.6		
Other paper/board shipments	Jan.	292	18.7	292	18.7
Woodpulp shipments (export only)	Jan.	563	4.6	563[6]	4.6
Operating rates	Jan.	89%	86%	89%	86%

1. American Paper Institute. 2. API, Bureau of Census, American Pulpwood Assn. 3. Fibre Box Assn., Paperboard Packaging Council. 4. North American/Scandinavian paper-grade market pulp. 5. Canadian Pulp & Paper Assn. 6. Not annualized. (s) = Shipments.

UNCOATED FREE-SHEET: Slow recovery continues

Grade structure: Uncoated free-sheet papers contain a maximum of 10% mechanical pulp with the balance being chemical woodpulp. Thus, uncoated groundwood papers are excluded. Also ruled out are cotton fiber papers, thin papers, and bristols. The major end uses are office papers (bond, forms bond, xerographic, tablet, and envelope) and printing papers (offset, cover, and text).

Production/capacity: For the third year in a row, U.S. industry set a new production record in 1985, outstripping the peak of the previous cycle (1980) by 1.7 million tons. More significantly, uncoated free-sheet was the only printing/writing grade to record an increase in 1985, and that was a healthy 5.6% jump. Since this outstripped the 5.0% capacity rise, operating rates increased.

The largest capacity expansion project in recent years has been the 350,000 tpy brought online in 1985 by International Paper Co. in Mobile, Ala., in a conversion from newsprint and kraft paper. The pace of capacity expansions for future years appears to be slowing down slightly from the hectic early 1980s, which saw capacity rise 22.2% from 1980 to 1985.

In 1986, the major expansions will be a new 230,000-tpy Georgia-Pacific Corp. machine at Port Hudson, La., and a 110,000-tpy conversion from market pulp at Boise Cascade Corp.'s Wallula, Wash., mill. Also in April or May, James River Corp. should complete its acquisition of Crown Zellerbach Corp.'s mills.

Outlook: Once again in 1985 the end uses represented by uncoated free-sheet did better than the economy as a whole. Excess capacity was a problem in 1984 and a somewhat smaller problem in 1985, but the excess is slowly being worked off. With economic activity growing respectably in 1986, it seems likely that a stable industry pricing policy will induce a stable growth pattern through the end of the year and allow the industry to repeat the impressive performance of 1985.

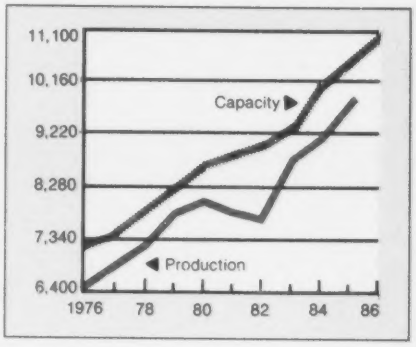
Some particular areas of promise can be seen. For example, forms bond shipments rose last year by about 6% and are expected to grow by another 4% to 6% in 1986. Another area that should do well this year is copy paper, which was up by 4% in 1985. Perhaps the critical question for the industry will be the performance of the commercial printing sector, which increased its use of uncoated free-sheet by about 3.5% last year. If advertising and promotional spending respond to the economic resurgence the way they usually do, uncoated free-sheet shipments to this area should rise even faster than in 1985.

Pricing: All pricing discipline was gone from the marketplace in the first quarter of 1985, when quotes for some commodity grades were as much as 25% below year-earlier levels—and heading down. But by April things had turned around and mills were able to get much of an announced $60/ton increase through. Some of it was lost again in the normally soft summer months. In October, prices headed up again, and by January quotes were a few points higher than in January 1985, with signs of further moderate increases on the way.

Price trends for two important grades are (year-end, $/short ton, list quotes except where transaction prices are considerably below list, when transaction averages are shown): book paper, No. 3 offset, 45-lb sheets—1976, $506; 1977, $545 to $555; 1978, $645; 1979, $711 to $717; 1980, $785 to $813; 1981, $878; 1982, $680; 1983, $840; 1984, $880; 1985, $800. Forms bond, 15-lb rolls: 1976, $520; 1977, $450 to $500; 1978, $538 to $550; 1979, $620; 1980, $643 to $697; 1981, $753; 1982, $640; 1983, $745; 1984, $680; 1985, $600.

Markets: Estimated shipments by end uses are: bond, mimeo, duplicating, xerographic—24%; forms bond—21%; offset printing—26%; envelope—11%; tablet—5%; others—13%. ■

SUPPLY/DEMAND (000 tons)



FORECAST (000 tons)

	1984	1985	1986e
Production[1]	9,207	9,722	10,218
Capacity[1]	10,058	10,562	11,030
Utilization rate	91.5%	92.0%	92.6%
Imports[2]	477	366	300
Exports[2]	65	66	70
Apparent U.S. consumption	9,619	10,022	10,448
lb/capita	81.69	84.29	87.03
GNP ratio	5.88	5.97	6.05

e = *P & P* estimate.
1. American Paper Institute data.
2. Commerce Dept. data.

TOP U.S. PRODUCERS (000 tpy)

	Annual capacity	Market share (%)
1. International Paper	1,100	10.0
2. Champion Intl.	955	8.7
3. Boise Cascade	810	7.3
4. Great Northern	810	7.3
5. Union Camp	724	6.6
6. Hammermill Paper	692	6.3
7. Weyerhaeuser	580	5.3
8. Georgia-Pacific	575	5.2
9. Crown Zellerbach	482	4.4
10. James River	370	3.4

Market share of top five companies:
39.9%

Market share of top ten companies:
54.4%

Total U.S. capacity (1986):
11,030 million short tons

SALES & EARNINGS

U.S. sales/earnings reflect tough competition, depressed economy

1985 will be remembered by the U.S. paper industry for difficult export markets due to a strong U.S. dollar, depressed prices for pulp, linerboard, and some white paper grades, and tough competition everywhere. Of the 30 companies whose annual sales and earnings results are shown in the table below, half reported a rise in total sales, but only one third raised their earnings.

Total 1985 sales for the 30 companies is $59 billion, a rise of 1.6% over 1984. Income from continuing operations came to $2.4 billion, a 14.8% drop from 1984 (excluding where possible major nonrecurring items). Reflecting difficult economic conditions in paper and wood products, several companies reported large writeoffs connected with restructuring.

TABLE 1: **U.S. paper/forest products industry results for 1985.**

	Full year ($000)			
Paper companies	**Sales**	**Change 1985/84**	**Earnings[1]**	**Change 1985/84**
Boise Cascade	$3,737,220	−2.1%	$104,290	50.0%
Bowater Inc.	904,004	1.8	67,520	8.0
Champion International	5,769,759	12.7	163,139[2]	13.3
Chesapeake Corp.[3]	454,063	29.6	15,694	−29.1
Consolidated	715,744	4.3	106,881	28.9
Crown Zellerbach	3,062,400	−1.0	79,400[2]	−23.1
Federal Paper	783,927	23.0	11,196	−69.8
Fort Howard Paper	1,363,292	1.8	157,010	18.0
Georgia-Pacific	6,716,000	0.5	207,000[2]	−18.2
P.H. Glatfelter	277,114	−10.9	38,612[2]	2.9
Great Northern Nekoosa	1,935,500	3.3	46,200	−61.5
Hammermill Paper	1,876,914	1.2	28,913	−48.3
International Paper	4,501,900	9.3	131,300[2]	9.3
Kimberly-Clark	4,072,900	12.6	217,500	22.8
Longview (10/31)[4]	459,058	−5.0	22,418[2]	12.2
Louisiana-Pacific	1,260,920	2.5	25,500[2]	8.7
Mead Corp.	2,740,400	0.7	93,500	−32.9
Mosinee Paper	187,724	−6.3	8,912	0.7
Pentair Inc.	534,198	−2.1	20,058	−5.6
Pope & Talbot	325,203	1.6	4,587	n.m.
Potlatch Corp.	950,323	−4.4	37,669	−24.1
Scott Paper	3,049,500	7.1	201,100	7.5
Jefferson Smurfit	630,425	−7.0	16,826	−31.3
Sonoco Products	869,598	17.4	49,409	16.2
Southwest Forest	700,092	−9.9	(12,323)	n.m.
Temple-Inland	1,243,100	−1.6	85,100	−17.1
Union Camp	1,865,871	−5.5	95,092	−47.6
Westvaco	1,721,783	−2.5	104,625	−19.5
Weyerhaeuser	5,205,579	−6.2	200,116[2]	−25.9
Willamette	1,152,067	−2.5	60,244	−9.0
Total	**$59,066,740**	**1.6%**	**$2,361,468**	**−14.8%**

1. Income after taxes, from continuing operations, excluding most significant nonrecurring items in both years.
2. **Champion**: 1984 nets exclude after-tax writeoff of $150 million for restructure of building products plants and timber contract expected losses. **Crown Zellerbach**: 1985 net excludes $106.2 million for restructuring; 1984 year excludes $30.1 million restructure charge. **Georgia-Pacific**: 1985 income excludes $30-million after-tax disposal of discontinued operations; partially offset by after-tax gain of $10 million from settlement of land dispute; 1984 net excludes after-tax loss of $134 million from discontinued operations. **Glatfelter**: 1984 net excludes $24.6 million gain from sale of paper mill. **International Paper**: 1985 nets exclude pretax gain of $56.5 million, sale of stock and pretax charge of $155 million from adjustments to facilities and investments and pretax gain of $16.8 million from land sale; 1985 income includes credit for cumulative effect of accounting change on prior years. **Louisiana-Pacific**: 1985 year net excludes $29.4 million for cumulative effect on prior years of accounting change; 1984 year net excludes after tax $18.7 million from sale of National Gypsum holdings. **Weyerhaeuser**: 1985 year included 53 and 14 weeks, compared to 1984; 1984 net excludes $44 million after-tax charge from writedown of facilities, etc.
3. Data include results of mid-1985 acquisition of Wisconsin Tissue and Plainwell Paper.
4. Fiscal year ends Oct. 31.
( ) = loss. n.m. = not meaningful.

Georgia-Pacific Corp. came in first in 1985 sales, with a volume of $6.7 billion, but its earnings dropped by 18.2% to $207 million. G-P's chairman and CEO, T. Marshall Hahn Jr., reported that 1985 was one of the best years for G-P building products, but that "operating profits in pulp and paper declined to $9 million from the $202 million in 1984." Hahn blamed weak prices, major equipment conversion projects at several mills, and a lengthy strike at one major mill for the plunge in income from pulp and paper operations. However, he stated, "we anticipate improvement in both of our industry segments in 1986."

Ranking second in overall company sales, Champion International Corp. reported 1985 revenues of $5.8 billion, up 12.7% from 1984. Champion's net income of $163 million was 13.3% higher than it was in 1984. For its paper segment, Champion reported 1985 income from operations of $401 million, up 30% from the $309 million in 1984. This increase is primarily due to inclusion of two former St. Regis group operations: publication papers and newsprint. Throughout 1985, coated paper markets held up well, but results for printing/writing grades were below 1984, and uncoated papers remained weak, reported Champion.

Commenting on the results, Andrew C. Sigler, chairman and CEO, said he was pleased with Champion's divestiture and restructuring. "Our challenge now is to become more cost-effective so we can prevail in this tough new environment," he said.

International Paper Co. reported a year-end net profit of $131.3 million compared with a year-earlier loss, but said that pretax earnings dropped 65% before interest costs and nonrecurring items. For all of 1985, IP reported that net rose 11%, but pretax earnings for the year fell 40% before interest expense and nonrecurring items. John A. Georges, chairman and

CEO, said that the strong dollar hurt shipments and prices in 1985 but added that the dollar's recent decline has begun to lift exports.

Weyerhaeuser Co. reported that total sales revenue of $5.2 billion was down 6.2% from the 1984 level, while net income of $200 million was down 25.9%. Company president George Weyerhaeuser said that he expected 1986 to be "considerably better" than 1985, partly because the drop in the dollar has already helped export markets for lumber, logs, and newsprint.

Tissue makers' good year. Kimberly-Clark Corp. and other sanitary papermakers had well-improved net income in 1985. On sales of $4.1 billion (12.6% above 1984), K-C had a net income of $217.5 million (22.8% above 1984). Scott Paper Co. had sales of $3 billion (up 7.1%) and net income of $201 million (up 7.5%)—both record highs for Scott. Philip E. Lippincott, chairman and CEO, attributed the rise "principally to strong performance in domestic and international sanitary paper product businesses."

Fort Howard Paper Co. reported sales of $1.4 billion (up 1.8%) and earnings of $157 million (up 18.0%). Fort Howard's chairman and CEO, Paul J. Schierl, said "tissue operations were strong throughout the year," but a high level of competition in disposable food and beverage service products caused a modest decline in sales for the fourth quarter.

Timber restructuring. Crown Zellerbach Corp. reported a net loss for 1985 of $26.8 million, including a net loss provision of $106.2 million for restructuring. The company said that income before unusual items was $79.4 million, compared with $103.2 million a year earlier (before a special item). The paper group (being acquired by James River Corp.) had operating earnings $91.7 million, down 21% from a year ago. Timber and wood products income, however, rose to $16 million vs $1.8 million in 1984, reflecting a streamlining of operations. (James River is on a fiscal year schedule; its earnings were unavailable at this writing.)

Paperboard and pulp difficult. "It was a buyers' market for paperboard and pulp in 1985," commented Mead Corp.'s chairman and CEO, Burnell R. Roberts. Mead's sales of $2.7 billion in 1985 were close to 1984 (up 0.7%), but net income of $93.5 million was down by 33%. Roberts expects improved demand in 1986. ■

Canadian mills did better in 1985 but could improve

The year 1985 will not go down in Canadian history as a great year for economic growth, but most Canadian pulp and paper companies reported improved sales and earnings compared with 1984. For example, British Columbia Forest Products Ltd. turned in its best performance since 1980, said K.P. Benson, BCFP's president and CEO. Most industry executives would concur with his comment, "while 1985 results were a big improvement over the four previous years, markets are still poor."

Of the dozen companies whose 1985 results are listed in the accompanying table, ten reported a growth in sales figures while eight showed improved earnings over 1984.

Efficiency improvements credited. Crown Forest Industries Ltd., returning to profitability after a loss in 1984, is "a leaner, more market-conscious producer, better able to compete in a difficult economic climate," said Ian Donald, Crown Forest's president and CEO. The company enjoyed its first profitable year since 1981.

Abitibi-Price Inc. rang up a 26% improvement in its 1985 earnings, and president and CEO Bernd Koken said that "among positive factors contributing to increased earnings were effective control over costs" as well as growing benefits from recent capital expenditures and inclusion of earnings from two acquisitions made during the year. Recent weakening of the Canadian dollar vs U.S. and overseas currencies is "having a positive effect on the company's international competitive position," said Koken. He expects further earnings improvement in 1986 due to expected increased demand for newsprint and groundwood papers and "a richer mix of higher-value papers."

MacMillan Bloedel Ltd. increased its 1985 net income by 122% over 1984, but MB president and CEO Ray Smith said "results show the company still has a long way to go to provide adequate return on equity investment. With no sharp growth in demand for our products expected, the challenge in 1986 is for labor and management to continue efforts to bring us in line with competitors."

Charles Carter, chairman and CEO of Great Lakes Forest Products Ltd., found that "the higher U.S. dollar made a big contribution to revenues, offsetting lower shipment volumes of kraft pulp and newsprint." ■

TABLE 2: **Canadian paper/forest products industry results for 1985.**

	Full year (C$000)			
Paper companies	**Sales**	**Change 1985/84**	**Earnings[1]**	**Change 1985/84**
Abitibi-Price	C$2,549,800	19.3%	C$100,200[2]	42.9%
British Columbia Forest Products	1,140,000	12.9	30,100	227.2
Cascades Inc.	266,272	48.2	19,443	53.8
Consolidated-Bathurst	1,727,000	6.4	79,800[2]	8.1
Crestbrook Forest Industries	142,012	2.9	(3,028)[2]	n.m.
Crown Forest Industries	853,000	15.2	16,600	n.m.
Domtar	2,129,500	4.2	96,100[2]	11.6
Donohue	425,000	−3.1	20,700[2]	−31.7
Great Lakes Forest Products	592,110	−1.6	3,550[2]	−80.2
MacMillan Bloedel	2,335,400	9.8	42,900	122.3
Rolland	300,700	5.7	5,200[2]	−27.6
Weldwood	628,831	9.9	7,384[2]	n.m.
Total	**C$13,069,825**	**10.0%**	**C$418,949**	**31.1%**

1. Income after taxes, from continuing operations, exluding most significant nonrecurring items in both years.
2. **Abitibi:** 1984 net excludes $2.2 million charge for sales of facilities; **Consolidated-Bathurst:** net excludes special charges in both years, for writeoff of some investments and plant closing; **Crestbrook:** 1985 income excludes special charge of $4.9 million for startup of pulp mill optimization program; **Crown Forest:** net for 1984 excludes extraordinary gain of $2.9 million timber trade. **Domtar:** 1984 omits $4.4 million special gain; 1985 excludes $14.3 million special gain; **Donohue:** 1984 figures have been restated to reflect effective tax rate for 1984; **Great Lakes:** 1985 net excludes special charge of $3.3 million for settlement of claims for mercury pollution in Wabigoon-English River system; **Rolland:** 1985 net excludes $935,000 gain from sale of property; **Weldwood:** 1984 net excludes $1.4 million special charge; 1984 resulted in losses.

( ) = Loss. n.m. = Not meaningful. n.a. = Not available.

LIQUID PACKAGING DECLINES IN MILK MARKETS BUT GROWS IN NEW END USES

New end uses are expected to ease the current overcapacity in carton board; aseptic packaging should boom as food processors experiment

By DEBRA A. ADAMS, Senior News Editor

Producers of liquid carton board have lost market share in milk packaging consistently over the past 15 years as plastics have carved out their own substantial niche. With better technology, improved products, and new expanding markets, though, paperboard is gaining once again.

Since 1970, milk carton stock tonnage has fallen fairly steadily from 941,000 short tons to 591,000 tons in 1982. In 1983, however, milk carton stock production was up by 2.7% to 607,000 tons and rose 6.3% in 1984 to 645,000 tons. In 1985, it fell more than 2% for the first three quarters, but some observers thought production might flatten out and end the year at about the same level as in 1984.

Some market observers attribute this leveling off in market share erosion to a campaign launched by the Paperboard Packaging Council, an industry trade association. The PPC program, sponsored by its member companies making liquid packaging board, was started in 1983. That same year, milk carton shipments began to turn around.

The PPC suspects the absence of its campaign in 1985 adversely affected shipments. The promotion was halted by a court injunction pending the outcome of a lawsuit charging the ads with false claims. Subsequently, the PPC was ordered to modify the content of its campaign (*P&P*, Nov. 1985, p. 31). The campaign was restarted early this year.

CAMPAIGN TO PROMOTE CARTONS. The PPC's promotion consists of television announcements to consumers in designated locations throughout the U.S., citing university reports indicating light can damage the nutritional content of milk and adversely affect its flavor. The campaign also introduced the paperboard gallon "two-pak" as an alternative to the plastic gallon jug in an attempt to regain some of that market.

Individual companies have also produced promotions for milk cartons. Aimed at dairies and retailers, as well as consumers, these advertisements note paperboard's superior graphic qualities that allow better product identification and point-of-sale advertising, in addition to underscoring the PPC's claims regarding vitamins and flavor, as well as other advantages.

Most of paperboard's loss of the milk packaging market share has been in the gallon and half-gallon sizes in the West and Midwest regions, according to S. Edward Iciek, PPC president. Since 1980 the erosion in the gallon size has eased, but now there is concern about further loss in the half-gallon market.

The paperboard container lost market share in the gallon size chiefly because it was an unwieldly package and cost more than plastic, observers said. Cartons in the half-gallon and smaller sizes are substantially more economically competitive than the gallon size. The opposite is true for plastic. It costs about the same to make a plastic gallon as a half-gallon, one marketing executive said.

Some feel plastics could capture as much as 50% of the market currently held by paperboard in the half-gallon segment of the market. Others feel the erosion will be less. Most, though, are convinced some shifting will occur.

The U.S. Dept. of Agriculture figures indicate that of the gallon containers of fluid milk sold in 1983 (the last year for which statistics are available), 96.7% were plastic and 3.3% were paperboard. In the half-gallon size, 86.9% were paperboard and 11.7% were plastic. In the

TABLE 1: **Fluid milk sales by package size and type.***

Container size	Total sales (million lb)	Type of container (percent of total sales) Glass	Paper	Plastic
Gallon	2,028.5	—	3.3%	96.7%
Three-quart	0.3	0	83.2	16.8
Half-gallon	794.6	1.4	86.9	11.7
Quart	174.4	1.7	97.1	1.2
Pint	53.4	—	99.5	0.4
Half-pint	333.4	0.1	99.5	0.4

*Sales for 1983 by handlers regulated in Federal Milk Order markets.
(—) Figures less than one tenth of one percent.
Source: U.S. Dept. of Agriculture.

TABLE 2: **Percent of fluid milk sales by package type.***

Year	Glass	Paper	Plastic	Other
1963	32%	63%	n.a.	5%
1966	25	67	6%	2
1971	7	78	15	—
1977	1	58	41	—
1983	—	38	62	—

*Represents total fluid milk, including whole, lowfat, and skim.
(—) Figures less than one half of one percent.
n.a. = Not available.
Source: U.S. Dept. of Agriculture.

smaller sizes, paperboard still had more than a 97% share of the market (Table 1).

According to USDA, total fluid milk packaging has shifted from paperboard having a 78% share in 1971 to 38% in 1983. During that time, plastic went from 15% to 62% (Table 2).

The PPC is hopeful that its campaign has halted the penetration of plastics into the gallon markets and that further erosion in the half-gallon and smaller sizes will not be significant.

In addition to the PPC promotional efforts, the market itself seems to be shifting back to paperboard due to outside influences. A study completed in 1985 by one research firm forecast a decline in demand for the gallon size by the year 2000 due to demographic factors.

The report indicates that the maximum number of people who buy gallon containers has already been reached and will decline with the projected decrease in the size of the average family. With smaller households, more smaller packages will be purchased. And most of these containers are likely to be made of paperboard due to its cost advantages over plastic in the smaller sizes, the study indicates.

Also, the market practice of pricing milk in gallons more cheaply on a volume basis compared with half-gallons is expected to change to make the price of each size more equitable, according to one close observer. He indicated that part of the problem with carton stock is retail prices that make larger containers cheaper by more than a few pennies.

NONMILK USES BOOMING. While demand for milk carton appears promising for the future, other end uses are also expected to ease carton board overcapacity. Demand for paperboard in the juice and nonmilk markets has risen from virtually nothing to an estimated 20%, according to industry estimates. Iciek noted that juice and juice drinks comprise about 20% of the total milk carton market now compared with 5% about 15 years ago.

Some suspect the trend to fresher foods has been a substantial factor in the shift of juices and other nondairy drinks from cans, bottles and other containers to paperboard. Cartons connote freshness, according to Earle Bensing, vice president and general manager of Champion International Corp.'s DairyPak Div. Last year, Champion introduced a new liquid packaging board called the "TasteSaver," which keeps juices fresher longer without a foil layer by using a polypropylene coating in addition to a polyethylene.

"The consumer likes refrigerated, fresh products," said Bensing. "If you look into the dairy case of a supermarket and see the amount of refrigerated products there, you can see one of the reasons that an aseptic milk has not been a success in this country."

Once concerned about plastics stealing markets from paperboard, many industry executives now expect plastics to help cartons in the long term. They think future combinations of resins with paperboard will produce better packages and increase paperboard volume over time. "With all these polymers, people are going to find many more uses for paperboard," said Clark Mounsey, vice president of Weyerhaeuser Co.'s bleached paperboard division.

ASEPTIC OPENS UP NEW USES. One of the most innovate packaging ideas to enter the market in recent years was the result of creatively combining synthetic fibers and paperboard. Known as the aseptic package, this container keeps foods fresh for months without refrigeration. It was only introduced in the U.S. in 1982, when it was approved by the Food & Drug Administration, but has existed in Europe and other countries for more than two decades.

While aseptic packages are an alternative container for such beverages as milk, they have not competed directly with milk carton board. In fact, aseptic packages should help the solid bleached sulfate (SBS) paperboard market in the future by providing another end use, industry observers noted.

Unfortunately, the growth in the U.S. aseptic market has not been as rapid as the industry had hoped. The North American market is estimated to be just 10,000 tpy. And of that amount, most of the aseptic board is imported from Europe and converted in the U.S.

Juices and juice-drinks are the most popular end use for aseptic packages currently, and most of these packages are produced by Tetra Pak, observers indicated. Combibloc Inc. uses some U.S. produced board, but Tetra Pak imports most of its requirements. One observer indicated that most U.S. board is inferior because no domestic milk carton machine has coaters sophisticated enough to meet the high quality standards of this type of packaging.

Most of the world's aseptic packaging comes from its inventor, Tetra Pak. A Scandinavian company with $2 billion in sales, Tetra Pak is estimated to have 90% of the world's market share of aseptic packaging. Combibloc, of Columbus, Ohio, is said to be the second largest producer, followed by International Paper Co., the latest comer to the marketplace.

IP GEARING UP TO BE NUMBER TWO. IP claims to have the most sophisticated extruder of its kind in the world. It can produce a nine-layer product with seven resin layers, and one layer each of aluminum foil and paperboard at its Raleigh, N.C., operation. The board is supplied from its mills in Moss Point, Miss., Texarkana, Texas, and Pine Bluff, Ark.

IP entered the aseptic business in 1981 when it bought world rights from an Italian company. It has since expanded sales to eight countries and expects to increase that number to 16 over the next few years, according to one IP executive.

IP is the only primary producer in the world also involved in leasing and selling aseptic machinery as well as providing the aseptic board, the company indicated. The world's largest supplier of milk carton board, IP plans to become the world's second largest producer of aseptic packaging by 1988, said David Fergus, marketing manager of IP's extended shelf life packaging division.

"There is a tremendous extension and expansion of the product expected in the next couple of years," he said. The juice and drinks market is expected to grow by 10% annually, while end-use markets such as mineral water, wine, edible oils, tomato purees and sauces, and other foods should grow at a faster rate, he said.

Most market observers agree with Fergus that aseptic will continue to grow at least 10% a year in some end uses in the next few years and double to a 20,000-tpy market in North America in five years. They say probably the biggest factor in its future growth is a willingness by food processors to experiment. Earlier this year, Campbell Soup Co. began test marketing 8¼-oz packages of soup in aseptic cartons. This board, which combines layers of paperboard, foil and polyethylene, is converted by Combibloc, according to Campbell.

Some observers feel that now Westvaco Corp. will be the next to try to cash in on the growing aseptic market. The company's new 175,000-tpy solid bleached sulfate machine at the Covington, Va., mill, which is slated to start up this spring, will be partially dedicated to supplying aseptic board, observers indicated. Westvaco refused to comment, however.

Despite the optimistic projections for its growth, observers are not hopeful that it will become a popular package for milk in the U.S. due to the availability of refrigeration. Its current market is based on convenience and is mostly used by children as a lunch box item.

"The synergy between the 'natural' juices and the convenient aseptic packaging has attracted the attention of a wide variety of consumers and appears to be expanding the category's overall niche," reported *Advertising Age* in its Sept. 19, 1985 issue. The magazine estimated that aseptics accounted for only 4% of the juice-drink sales in 1984. And the market is growing. *Beverage Industry*, a trade publication, reported sales of pure juices were up 2% in 1984, while ready-to-serve—the segment that includes aseptics—spurted ahead 15%.

TABLE 3: **Milk carton production, 1960-87.**

Year	Production (short tons)	% change*
1960	571,000	n.a.
1965	752,100	+31.7
1970	940,700	+25.1
1975	865,800	−8.0
1980	677,600	−21.7
1985 (P)	607,800	−10.3
1987 (E)	645,000	+6.1
1980	677,600	—
1981	631,800	−6.7
1982	590,500	−6.5
1983	606,900	+2.8
1984	645,100	+6.3
1985	607,800	−5.8

*Figure represents percentage change from prior year in order indicated in table.
n.a. = Not available.
P = Preliminary.
E = Estimate from Morgan Stanley.
Source: American Paper Institute.

Frost & Sullivan, a New York, N.Y.-based research company, expects sales for the entire juice and drink category to increase at a 3% annual rate but sees 100% juice blends leading the way with a 20% growth rate.

OVERSEAS MARKETS TO GROW. While the outlook for liquid carton demand in the U.S. looks good, the prospects in overseas markets is even better. The U.S. produces about 1 million metric tpy of the 1.7 to 1.8 million tpy of demand for liquid packaging board worldwide, according to one estimate.

In Europe, for instance, plastics are not a high-growth market. For one thing, Europeans prefer smaller cartons, with the liter being the largest size. In addition, milk consumption is higher than in the U.S.—especially in the Scandinavian countries—and continues to grow. Currently, Europe consumes about 750,000 metric tpy of liquid packaging board. Also, the switch to paperboard from glass—which began in the U.S. decades ago—continues in Europe.

Various changes in customer preferences around the world is also having a beneficial effect on the liquid packaging board market due to increasing preference for higher-quality graphics, and more durable containers, as well as other characteristics. "We believe that there will be better printing in the future, with offset and gravure. Flexography is acceptable for the most part, but as we get into more drinks and juices those companies are going to want a package that looks like a label on a can or bottle," said Champion's Bensing.

In addition to new extruded coatings to improve containers, Champion is also investing about $17 million in its No. 19 milk carton stock machine at the Canton, N.C., mill. This will upgrade the strength and print surface of the board, Bensing noted.

EMERGING TRENDS WILL HELP. Better graphics is one of the key reasons why many observers expect that the infiltration of plastics into the milk containers market will flatten out, especially in sizes smaller than a gallon.

Alvin Schechter, president of Schechter Group, a New York-based packaging design company, underscored the importance of graphics in aseptic and other types of packaging. "If past history holds, marketers will put in metallic paper, better-quality paper, and other distinguishing characteristics to make a quality presentation," he said.

Strength is another consideration as the industry moves more into juices and other nonmilk areas. "One of the major differences or challenges in packaging juice or drink items over milk is the longer shelf life. The longer a liquid is held the more demand it puts on a package," said Bensing. Usually, milk has a shelf life of no more than 12 to 14 days, while juices and other beverages typically can last 30 days or longer.

To keep pace with increasing demand for higher-quality board suited for a variety of end uses, milk carton producers in recent years have been investing in various technological improvements.

IP noted that its decision to launch into the aseptic market was based on its belief that cartons would be evolving in the coming years. "With the standard liquid packaging business losing to plastics, it became obvious to IP that if we wanted to preserve our share as the world's largest worldwide supplier of board, we had to get into aseptic packaging," said Stan Bryant, general manager of IP's extended shelf life packaging division.

While many of the milk cartons produced worldwide are licensed by Ex-Cell-O Corp.—inventors of the gable-top container—producers continue to make variations in the basic package as well.

Weyerhaeuser, for instance, is currently test marketing a gable-top package for oil. The container, developed with Ex-Cell-O Corp. and produced at Weyerhaeuser's plant, is about the same dimensions width-wise as a half-gallon milk carton container but half as tall.

Other producers are testing containers for other products. One, a wine package, also resembles a gable-top milk carton. Water packaging using carton board is also being developed.

With these new packages and emerging markets, bleached board producers in general and milk carton manufacturers in particular hope to win their fight for market share. They feel they may have halted the competition's advance, if not actually instigated its retreat. ■

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MILLS OFTEN OVERLOOK SIGNIFICANT WATER RECYCLING OPPORTUNITIES

The U.S. pulp and paper industry is the nation's largest consumer of process water, yet chances for water use reduction are often missed

By J. CRAIG WYVILL, P.E., JOHN C. ADAMS, P.E., and G. EDWARD VALENTINE

Water is a critical element in the production of pulp and paper products. Almost every manufacturing step requires the use of significant quantities of water. This high process water demand combined with the tremendous production output of the industry makes the paper and allied products industry one of the largest water users of all U.S. manufacturing industries. Historically, the pulp and paper industry has made a conscientious effort to reduce its dependence on freshwater through conservation and recycling/reuse measures.

INDUSTRY WATER CONSUMPTION. The U.S. leads the world in the production of paper and paperboard products. More than 700 facilities in this country are currently involved in the manufacture of pulp, paper, and paperboard products. In 1975, these facilities withdrew 8.9 billion gal/day of water, making them the third-largest industrial water-using group in the nation, behind the chemical products group and the primary metals group. Unlike most other water-using industries that apply the majority of their water to cooling cycles, the pulp and paper industry uses more than 60% of its water withdrawal for manufacturing. This makes it the largest industrial process-water user in the nation.

Recent production statistics for the industry show that 72% of all production and 85% of all water withdrawal are achieved by 189 mills in ten general production categories. Table 1 presents a geographic breakdown of these mills, listing the number of mills in each of 15 regions together with their total water withdrawals. This breakdown shows that two-thirds of these withdrawals occur in three regions: the South Atlantic, lower Mississippi and the Pacific Northwest.

Mr. Wyvill and Mr. Adams are research engineers, and Mr. Valentine is a research scientist. All are associated with Georgia Institute of Technology's Engineering Experimental Station in Atlanta, Ga.

EXTENT OF WATER RECYCLING. During the past 30 years, mills across the U.S. have made giant strides in reducing their dependence on freshwater. Industry-wide data show a reduction from an average of 39,000 gal/ton in 1955 to about 27,000 gal/ton in 1972. In 1975, the paper and allied products sector had the second-highest water recirculation ratio in the U.S., behind only the petroleum and coal products sector.

The recent force of environmental regulation coupled with the more long-standing economic incentives to conserve chemicals, energy, and fiber help explain the significant capital expenditures for recycling measures. The results of these endeavors are clearly evident today. Table 2 shows both the 1981 average freshwater usage rates for typical mills in various production categories together with the best achieved by a mill in each category. On average, these values are well below even the 1972 levels mentioned earlier.

OPPORTUNITIES FOR EXPANDED RECYCLING. As stated earlier, it is difficult to make broad generalizations regarding common recycling combinations employed in the pulp and paper industry. Nearly every mill was found to have a unique approach to applying water recycling measures. The resultant variation in water demand for different types of mills is evident in the values

TABLE 1: **Regional distribution of pulp and paper mills in major producing categories and their estimated water requirements.**

Region	Number of mills	Water usage (000 gal/day)	Percent of total water
New England	21	250	6.7
Mid Atlantic	16	218	5.9
South Atlantic	47	1,391	36.7
Great Lakes	21	180	4.8
Ohio	10	91	2.4
Tennessee	3	74	2.0
Upper Mississippi	10	76	2.0
Lower Mississippi	16	420	11.3
Souris-Red Rainy	1	25	0.7
Arkansas White-Red	4	37	1.0
Texas-Gulf	6	166	4.5
Lower Colorado	1	12	0.3
Pacific Northwest	26	711	19.1
California	5	50	1.3
Alaska	2	47	1.3
Total	189	3,748	100.0%

displayed in Table 2. The gap between average and best achieved in each category is often very significant. Recycling strategies were observed to be dictated by various factors such as cost savings, resource conservation and recovery, and environmental restrictions.

The costs associated with excessive freshwater use are many and varied. They include freshwater supply cost, waste treatment of the additional effluent volume, added thermal requirements to offset the cooling effect of freshwater usage, and additional chemical costs to maintain proper whitewater conditions.

Table 3 shows observed monthly costs associated with pumping and treating groundwater. The average monthly delivery costs for this operation were approximately $0.14/1,000 gal, and waste treatment costs averaged $0.24/1,000 gal. These figures do not include the capital costs associated with drilling a well or constructing the treatment plant. Because this particular production facility had been in existence for more than 20 years, these costs were no longer taken into account.

An observation made while visiting mills throughout the country was that there are some recycling schemes that have broad technical potential and general economic attractiveness and yet for one reason or another are not widely employed in the industry. Listed below are four such schemes which could have a substantial impact on future water demand if broadly employed.

MACHINE SHOWERS. A much discussed method of reducing machine freshwater usage is to utilize whitewater on wire showers, headbox showers, and various other low-pressure, high-volume applications. Yet few mills use these concepts to any notable extent. The reason most often given is the expense and attention required to keep whitewater showers operational.

Mills with a strong motivation for recycling are finding ways to utilize whitewater extensively on the paper machine. Most employ showers with self-purging, large-orifice-size (0.05- to 0.06-in.) nozzles incorporated with 60-mesh strainers. This typically results in satisfactory performance and operation. Studies on shower pluggage have indicated that pluggage is a result of whitewater particles longer than 0.1 in. In the absence of long fibers, levels above 3,000 ppm of contamination have worked satisfactorily in conjunction with conventional self-purging nozzles. Whitewater showers can reduce machine freshwater requirements by almost 500 gal/ton for a model 600-tpd machine.

From the example of treatment and pumping costs outlined in Table 3, the costs associated with drawing and treating groundwater for this operation could amount to nearly $0.46/ton of product based on a flow of 500 gpm. This amounts to over $97,000/year in savings for a 600-tpd machine if whitewater recycling is instituted.

The thermal and chemical costs associated with excess freshwater usage are equally significant. Consider the same 600-tpd machine operating at a temperature of 140°F and a pH of 5.0. If freshwater were utilized on the low-pressure applications, such as wire knockoff showers, grooved roll showers, etc., a net cooling would result. At a rate of 500 gal/ton, maintaining machine operating temperature would require 6.24 million Btu/hour, or $210,000/year (assuming a delivered heating cost of $4/million Btu and a freshwater supply of 80°F). Correspondingly, it would require an additional 0.56 lb/ton of acid to reduce the freshwater pH to 5.0. These additional costs could approach $3,000/year for sulfuric acid at $50/ton.

The total costs associated with the use of freshwater instead of whitewater showers could exceed $300,000/year for a 600-tpd machine. While it could be argued that the thermal heating cost is unrealistic since most mills use waste heat from digester blows or waste low-pressure steam for this application, this is not necessarily true. Only if this waste heat could not otherwise be utilized would this be accurate. As long as purchased fuels are used to generate heat, all waste streams should be utilized at the point in the process where they can be optimally beneficial. The waste heat from digester flows

TABLE 2: **Comparison of average water usage vs the lowest for the ten major production categories.**

	1981 average water usage (gal/ton)	1981 lowest water usage (gal/ton)
Dissolving kraft	44,200	34,500
Market bleached kraft	35,000	17,000
BCT bleached kraft	37,600	24,800
Alkaline fine paper	44,900	19,500
Unbleached kraft	15,800	5,600
Unbleached kraft & supercalendered	11,400	7,300
Dissolving sulfite	70,600	66,700
Papergrade sulfite	51,400	9,300
Miscellaneous integrated	27,500	5,500
Nonintegrated fine paper	18,400	5,600

TABLE 3: **Monthly self-supplied delivery and wastewater treatment costs for a southern plant.**

Monthly expenses	Delivery ($)	Wastewater ($)
Power	$4,887.50	$9,775.00
Labor	4,125.05	1,625.52
Chemical treatment	1,822.23	1,152.12
Maintenance	317.67	55.67
Total	**$10,951.45**	**$12,808.31**
Monthly output	**Delivery (gal)**	**Wastewater (gal)**
Plant	76,382,000	53,028,417
Filter backwash	1,282,750	
Total	**77,664,750**	**53,028,417**
Unit cost (per 1,000 gal)	$0.14	$0.24

and low-pressure steam might be better used for other applications such as bleaching, brownstock washing, or boiler feedwater heating if waste heat can be recovered in the paper machine by recycling whitewater.

Costs of instituting a program to utilize whitewater showers range from minimal to as much as $150,000/machine. Very low costs are usually associated with those mills that have bypassed old recycling systems for one reason or another. These mills need only to invest in modern filtration and shower equipment to bring their system up to date, thereby eliminating problems associated with older designs. Table 4 shows that a simple payback for the worst case would still be less than one year, including maintenance costs.

FELT SHOWERS. As with machine showers, felt showers also can use whitewater recycling. Another technique for reducing freshwater demand is high-pressure shower heads. It has been reported that a representative machine's felt shower water requirements can be reduced by over 93% by using high-pressure, intermittent showers. Table 5 shows a comparison of a conventional low-pressure system vs a proposed high-pressure system. For most mills this high-pressure approach, even though using freshwater, is more attractive than using high-volume, conventional showers with whitewater recycling. Both concepts offer advantages. Some combination of the two technologies may actually prove most desirable by reducing the capital costs related to whitewater clarification and the operating costs associated with reduced felt life from the high-pressure (up to 700-psi) showers.

The cost savings associated with modifying felt showers can be estimated by using an approach similar to that for whitewater machine showers. Assuming that half of the total freshwater demand shown in Table 5 is actually required, with the remainder being whitewater, then net freshwater use could be reduced by 500 gal/ton on a 600-tpd machine. This yields a potential savings offered above by using whitewater showers in the forming section.

However, felt life and efficiency could be adversely affected. Further, the corresponding whitewater chemical constituents and felt material may not be optimally suited. These problems can be addressed by changing to higher-synthetic-content felts and using lower shower pressures.

Costs for felt shower modifications have gone as high as $300,000, excluding operating expenses, and have had simple paybacks exceeding two years. However, the approach may have more merit as a capital avoidance measure for mills considering the costly expansion of waste treatment facilities.

Avoidance of waste treatment costs is not always considered by mills since most operate their own facilities and treat them as fixed capital assets. Many mills consider operating costs to be relatively constant whether the facility operates at full volumetric load or some fraction thereof. Chemical and aerating expenses are less sensitive to volumetric load than they are to BOD_5 load. Increased recycling can reduce waste volume, allowing either greater retention or more flow in existing waste treatment plants.

Consider a bleached kraft mill waste treatment plant handling 80 lb of BOD_5/ton of production and 40 million gal/day of effluent. Given a 10-day retention period of aerated and nonaerated lagoons, 64,000 lb of BOD_5 can be consumed daily. If this same mill instituted improved recycling schemes that reduced effluent volumes by 5 million gal/day, then even with the same level of BOD_5 emissions, the existing waste treatment plant would be capable of handling the additional 5,000 lb of BOD_5/day. This extra capacity could be utilized either to handle a production increase of 78 tpd of paper or to provide a safety cushion in meeting existing permitted levels.

VACUUM PUMPS. The freshwater requirements for vacuum systems can account for as much as 1,800 gal/ton of machine production. Most mills meet this requirement with freshwater because of the potential for corrosion problems often associated with using whitewater in carbon steel pumps.

TABLE 4: **Simple payback calculation for whitewater showers.**

Installation cost (I)	= $150,000
Operation and maintenance cost (O)	= $ 55,000/year
Annual savings (S)	= $250,000/year
Simple payback = $\frac{I + O}{S}$	= 0.82 years

TABLE 5: **Comparison of a conventional paper machine shower system with a high-pressure, low-volume system.**

	Conventional low-pressure system (gal/day)	High-pressure low-volume system* (gal/day)
Purge-type roll shower	389,000	29,000
Felt wetting	150,000	Eliminated
Felt cleaning	58,000	4,000
Felt lubrication shower	43,000	9,000
Total water	**640,000**	**42,000**

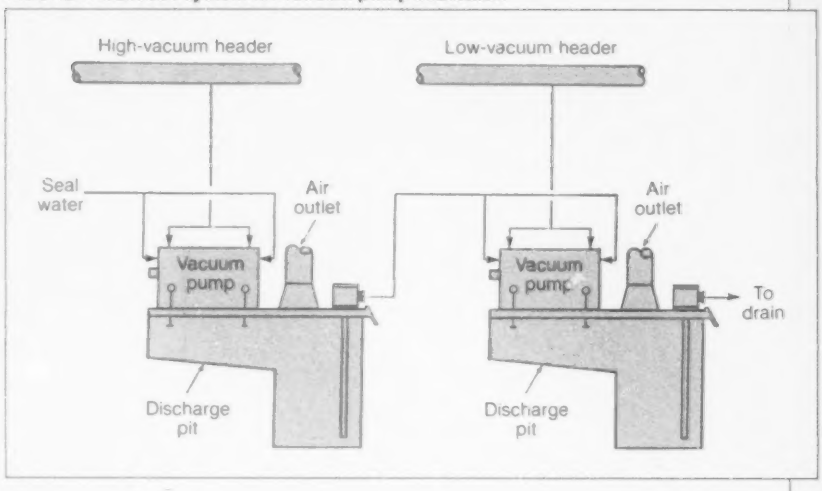
* Intermittent shower at 90 min/day.

TABLE 6: **Cost reductions associated with converting to vacuum pump cascade sealwater system.**

Freshwater use cost (C)	= $0.36/thousand gal
Vacuum pump freshwater use reduction (U)	= 900 gal/ton of product
Annual machine production (P)	= 213,000 tpy
Cost reduction = C x U x P	= $72,800/year

Some mills have built closed whitewater systems for the vacuum pump seal system designed to reduce freshwater consumption. Such schemes reduce water requirements by 90%. Cascading sealwater from high-vacuum pumps to low-vacuum pumps before sewering is another approach (Figure 1). This technique offers up to a 50% reduction in water use at low capital cost. Both approaches require adequate air/liquid separators in vacuum lines to control machine whitewater chemical buildup in sealwater systems. The advantages of a separate water recycling system in vacuum pumps include fewer scale and corrosion problems in addition to greater vacuum reliability related to better sealwater temperature control.

FIGURE 1: **Cascade system for vacuum pump sealwater.**



A third alternative for reducing freshwater use in pumps is the elimination of sealwater requirements by converting to dry, lobe-type vacuum pumps. This high-capital-cost alternative was found unattractive unless there were specific replacement opportunities, such as the retirement of an existing pump.

From observations on all three systems, it can be said that unless strong economic incentives exist to convert to a closed sealwater system, the most viable approach is to convert to a cascade sealwater system. Savings justifications are typically reported only on reducing the cost of freshwater use, unless the mill currently recycles vacuum system effluents to the machine whitewater system. The cost for converting to a vacuum pump cascade system was as high as $65,000, including an additional seal pit, adequate filtration, and temperature control. The resulting 50% reduction in freshwater use does yield a net annual savings of nearly $73,000 (Table 6). Using the aforementioned $0.38/1,000 gal usage cost for a model 600-tpd machine, simple payback can be less than one year barring additional maintenance costs.

PROCESS WATER SUPPLEMENT. One southern mill has instituted a unique water recycling scheme resulting in a reduction of freshwater consumption by nearly 7 million gal/day. The principal motivation for the reduction was the high cost of waste treatment performed by the nearby municipal facility. The basic recycling technique involved rerouting approximately 50% of the paper machine effluent (after screening) back to the freshwater clarifier for dilution and fiber flocculation. By this method, roughly 50% of the mill process water is comprised of machine effluent. Table 7 shows an estimated savings of $225,000/month based on municipal waste treatment rates of $0.67/1,000 gal and water costs of approximately $0.20/1,000 gal. Energy savings for the project have not been quantified, but steam production has decreased by 15,000 to 20,000 lb/hour. Assuming an average steam savings of 20,000 lb/hour, with 30% being generated by fossil fuels, annual fuel savings will be $102,000 as shown in Table 8.

CONTINUING CHALLENGE. The future of water recycling in the U.S. pulp and paper industry is bright. The industry has proven technologies it can use to bring about considerable savings in freshwater withdrawal.

Continued research is still needed to bring advanced studies, such as those in closed-cycle, counterflow techniques and state-of-the-art filtration concepts, to the point where they are suitable for the use throughout the industry. The current risks in these programs are high but the anticipated benefits are strong enough to justify investment. The continuing challenge for the industry will be its ability to keep guarding and conserving this precious and limited resource. ■

TABLE 7: **Identification of savings possible with whitewater blending at mill process water inlet.**

	Without recycling	With recycling
Freshwater intake (gal/day)	16,000,000	9,000,000
Monthly freshwater cost	$ 98,000	$ 55,000
Monthly wastewater treatment cost	$366,000	$184,000
Total	**$464,000**	**$239,000**
Net savings: $225,000/month		

TABLE 8: **Fuel savings associated with whitewater recycling to process water inlet.**

Steam rate (R)	= 20,000 lb/hour
Fraction of steam generated (F)	= 30%
Steam cost (C)	= $2.00/thousand lb
Annual operation period (P)	= 355 days, 24 hours/day
Savings = R x F x C x P = $102,000/year	